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FACTOR PRODUCTIVITY AND IRRIGATION

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(A CROSS-SECTION TEMPORAL ANALYSIS)

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PUBLICATIONS

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FACTOR PRODUCTIVITY AND IRRIGATION IN INDIAN AGRICULTURE

(A CROSS-SECTION TEMPORAL ANALYSIS)

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Planning for higher productivity has generally been accepted as an instrument for accelerated economic development. Almost all the developing countries have embarked upon the developmental planning in order to attain higher levels of income and output which largely depend upon the higher productivity.[1] Hence raising of productivity particularly in Indian agriculture assumes an issue of crucial importance primarily because of manifold reasons. First, agriculture is the largest sector of economic activity and its contribution to the national income is approximately 42 per cent.[2] Second, it provides not only food and raw materials but also employment to a very large proportion of the population. Third, besides helping to earn valuable foreign exchange, increased income of agriculture also enhances market demand for industrial consumption goods thereby providing stimulus to industrialisation and expansion of tertiary sector.[3] Finally, because of the unfavourable land-man ratio resulting from the rapidly growing population and the very little prospect of expansion in net area sown, augmenting yield per ha. has become the prominant source of growth of agricultural output.[4]

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In view of its vital role, all-out efforts have been made in India to augment levels of agricultural production and productivity during the period of planned development. However, the strategy of agricultural development went on adapting to achieve the national goal of providing adequate means of livelihood to each family and ensure a better exploitation of the local resources.[5] Following the 'top-down' approach during the period prior to the Fourth Plan, efforts were made to maximise growth rate in agriculture through implementation of Intensive Agricultural District Programme (IADP), Intensive Agricultural Area Programme (IAAP) and the Green Revolution.[6] With the result, some definite progress in agriculture in terms of growth and structural changes was quite revealing. But non-percolation of benefits to small and marginal farmers primarily because of their inability to finance input purchases was identified as the basic lacuna with the then on-going strategy of agricultural development.

In order, therefore, to cope with the above identified problem, the revised strategy tuned towards 'bottom-up' approach and based on mechanical and bio-chemical innovations[7] was adopted and the programmes of Command Area Development (CAD), Small Farmers Development Agency (SFDA), Marginal Farmers and Agricultural Labourers (MFAL) and Drought Prone Area Programme (DPAP) were launched during the Fourth and the Fifth Plans.[8] Consequently, agricultural production at the national level has gone up, significant advances have been made in yield levels of some important crops and a definite shift is perceptible in favour of high value crops. Besides, some definite improvements in

total and factor productivities are also expected to have taken place at the state level during seventies, in spite of the likelihood of prolonging inter-regional variations in levels of agricultural productivity obviously because of the differences in input use, levels of efficiency and the temporal effect.[9] With this background, the correct interpretation of productivity situations in Indian agriculture is deemed to be the dire need of the hour for formulation of definite, coordinated and unified policies for future.[10]

II. Objective and Issues

The present paper, therefore, attempts to assess the role and importance of input factors in agricultural production and productivity and analyse the changes in levels of factor productivities in agriculture in various regions of India at two points of time (i.e. 1970-71 and 1980-81), besides shedding light on the following basic issues :

1. To what extent the selected independent variables are capable of explaining the total variation in agricultural productivity;
2. Whether irrigation plays the most contributory role in agricultural productivity among the set of the selected independent variables;
3. How far the factor productivity is responsive to the intensity of input use;
4. Whether additional workforce employed in agriculture during seventies has resulted in reduction of the marginal productivity of agricultural workers; and
5. Is there any consistent relationship between the investment on irrigation and the potential created.

III. Methodology

Agricultural productivity of a country or a region is largely influenced by a complex set of variables ranging from physical and measurable ones through climatic to the difficult-to-measure socio-institutional factors. These variables consist of mainly climate, rainfall, cultivated land, irrigation, fertilizer, pesticides, workforce, mechanical power, livestock, seeds, managerial and supervisory services and socio-economic institutional factors.[11] Because of these variables being so numerous, complex and interrelated, their broad classification is hardly possible on scientific lines. However, these may be put into three categories of natural, organisational and technical factors.[12] Variations in the total or factor productivity may be due to any or all of these variables, values of which might vary from region to region and over time. From the very nature of these variables, it is quite understandable that even most exhaustive specification of these variables is going to omit at least few. Therefore, only four variables - value of agricultural produce per ha. of net area sown[13] as dependent and consumption of fertilizer per ha. of cropped area, irrigation coverage and strength of agricultural workers per 00 ha. of net area sown as independent - have been considered here for working out estimates of factor productivities. The following log-linear multiple regression model is used to carry out an inter-temporal analysis of the relative contributions of the selected independent variables to agricultural productivity and the changes thereof :

$$y = A.x_1^{\alpha_1} \cdot x_2^{\alpha_2} \cdot x_3^{\alpha_3} \cdot \quad \ldots\ldots\ldots \text{(i)}$$

where,

A = constant

y = value of agricultural produce per ha. of net area sown;

x_1 = consumption of fertilizer per ha. of cropped area;

x_2 = irrigation coverage;

x_3 = number of agricultural workers per 00 ha. of net area sown;

α_1 = Elasticity of agricultural output in respect of fertilizer;

α_2 = Elasticity of agricultural output in respect of irrigation; and

α_3 = Elasticity of agricultural output in respect of agricultural workers.

In all, 15 states of the country could be considered here as observational units for purposes of the present analysis primarily because of the non-availability of data for rest of the states and union territories. Of the selected two points of time (i.e., 1970-71 and 1980-81), the former is taken to represent the year by that almost all the states in India had adopted the revised strategy of agricultural development based on the bio-chemical innovations. Whereas the year 1980-81 is selected to analyse the impact of technological innovations on agricultural productivity.

The cross-section data used in this paper has been compiled for different states from the secondary sources, which consist of mainly Harvest Price in India, Ministry of Agriculture, Government of India, State-wise Irrigation Statistics, Ministry of Irrigation, Government of India, Bulletin of Agricultural

Statistics, Directorate of Agriculture, Uttar Pradesh, Lucknow and Inter-State Comparative Statistics, State Planning Institute, Lucknow.

IV. Regional Variations in Levels of Factor Productivity in Indian Agriculture

To analyse the functional relationship between the value of agricultural produce per ha. of net area sown and the selected independent variables, the estimates of factor elasticities as worked out through application of least square method, separately for the years 1970-71 and 1980-81 are given below :

Table 1 : Estimates of Factor Elasticities for 15 States of India

Sl. No.	Variables	Elasticities	
		1970-71	1980-81
1.	Fertilizer	0.0838 (0.6311)	0.2734 (2.4947)*
2.	Irrigation	0.4645 (2.8986)*	0.4745 (2.7505)*
3.	Agricultural Workers	0.2633 (1.6383)	0.1532 (1.07147)
	Sum of Elasticities	0.80	0.89
	R^2	0.7228	0.8194

*Significant at 5 per cent level

Note : Figures given in parentheses denote t - values

According to the above table, the decreasing return to scale operated in Indian agriculture during the previous decade as witnessed by the sum of elasticities which was less than one for value of the agricultural produce in respect of all the selected independent variables. However, there appears to have been some definite improvement in the performance of agriculture in India during the period as witnessed by an

increase in the sum of elasticities from 0.80 in 1970-71 to 0.89 during 1980-81. This kind of structural transformation is found to be significant during seventies as reflected by the variance ratio of 6.06 which is much greater than the tabulated value of F(4.22) at 1 per cent level of significance, i.e. 4.31.

A significant increase in the value of R^2 from 0.72 in 1970-71 to 0.82 during 1980-81 indicates that independent variables have been able to explain a larger proportion of the variation in agricultural productivity in India during the previous decade. Probably, this is because of reduction in regional effects on the production function followed by reduction in the inter-state variations in relative prices of agricultural commodities resulting from the recent development in road transport and communication facilities in India.

It is also noticed that there has been a sharp reduction in the elasticity of value of agricultural produce per ha. of net area sown in respect of agricultural workers during the reference period on one hand and the significant rise in the strength of agricultural workers on the other. The latter does not seem to have proved effective to a desired extent in augmenting the production and productivity levels in agriculture. Furthermore, it deciphers from the elasticities of the other selected variables (i.e., irrigation and fertilizer) that irrigation with statistically significant t-values played the most contributory role in agricultural productivity during both the selected years. Besides, fertilizer stood at second and occupied the position only next to irrigation during

1980-81. The relative sizes of the elasticities of these two variables indicate that value of agricultural produce per ha. of net area sown has been most responsive to both irrigation and fertilizer in the existing macro-economic structure of Indian agriculture during seventies.

The economic inefficiency, however, noticed in Indian agriculture during seventies might be attributed to the existing inter-state differences in entrepreneurial ability and knowledge of the farmers. Owing to these differences, farmers generally fail in making a proper choice of the best technology available (technical efficiency) on one hand and the input combinations (price efficiency) on the other.[14] This has finally led to a wide variation in marginal productivity of the selected variables from one state to another, as would be evident from Table 2.

According to the table 2, the marginal productivity of irrigation (MPI) showed an increasing trend at the national level during the previous decade. The MPI in most of the developed states using high-yielding input combinations (higher irrigation coverage with higher dosages of fertilizer) appreciably increased, whereas the corresponding figures in most of the developing states using low-yielding input combinations (lower irrigation coverage with lower dosages of fertilizer) showed a considerable decline. Moreover, the marginal productivity of fertilizer (MPF) appreciably increased at the national as well as regional levels during seventies. Contrary to this, the marginal productivity of agricultural

Table 2 : Percentage Increase (+)/Decrease (-) in Marginal Productivity of Irrigation, Fertilizer and Agricultural worker During the Period 1971-81

Sl. No.	States	Marginal Productivity of Irrigation 1971	Irrigation 1981	Irrigation % increase (+)/ decrease(-)	Fertilizer 1971	Fertilizer 1981	Fertilizer % increase (+)/ decrease(-)	Agricultural Worker 1971	Agricultural Worker 1981	Agricultural Worker % increase (+)/ decrease(-)
A.	Developed States									
1.	Tamil Nadu	15.08	14.51	- 3.78	2.68	4.89	+ 82.46	2.40	1.16	-51.67
2.	Punjab	11.07	15.25	+37.36	2.67	3.80	+ 42.32	7.36	5.62	-23.64
3.	Haryana	14.79	15.13	+ 2.30	5.47	7.25	+ 32.72	6.79	4.21	-38.00
4.	Kerala	17.62	31.34	+80.95	2.38	5.04	+111.76	1.40	0.98	-30.00
5.	Uttar Pradesh	16.02	15.91	- 0.69	4.75	7.09	+ 49.26	2.90	1.89	-34.83
6.	Andhra Pradesh	12.17	13.27	+ 9.04	2.52	4.48	+ 92.06	1.77	1.00	-43.50
7.	Gujarat	24.48	25.56	+ 4.41	3.12	6.72	+115.38	2.92	2.14	-26.71
8.	West Bengal	27.42	28.72	+ 4.74	9.85	10.71	+ 8.73	3.13	1.63	-67.92
B.	Developing States									
1.	Himachal Pradesh	30.09	34.11	+13.36	8.89	10.79	+ 21.37	1.67	0.94	-43.71
2.	Bihar	14.34	13.21	- 7.88	5.98	11.02	+ 84.28	1.30	0.77	-40.77
3.	Karnataka	24.05	25.77	+ 7.15	3.20	6.09	+ 90.31	2.32	1.32	-43.10
4.	Orissa	22.96	21.75	- 5.27	14.02	18.83	+ 34.31	2.31	1.25	-45.89
5.	Maharashtra	30.03	27.68	- 7.83	3.72	7.25	+ 94.89	1.94	1.14	-42.27
6.	Rajasthan	10.01	10.29	+ 2.80	8.02	12.43	+ 54.99	2.29	1.31	-42.79
7.	Madhya Pradesh	32.48	23.61	-27.31	10.38	16.00	+ 54.14	2.17	1.16	-46.54
	INDIA	16.97	17.15	+ 1.06	4.29	6.80	+ 58.51	2.33	1.42	-39.06

Notes : 1. Marginal Productivity of the selected factors is estimated by using the formula: Output/Factor input . Factor elasticity (α).

2. Classification of states into 'developed' and 'developing' categories is based on the author's paper 'Regional Variations in Levels of Agricultural Development and Productivity in India', Working Paper No.71, Giri Institute of Development Studies, Lucknow, 1985.

workers (MPAW) experienced a sharp decline at these levels during this period. Thus, variations in efficiency of inputs seem to play a dominant role in explaining variations in output per unit of measured inputs. Precisingly, adoption of irrigation fertilizer technology in Indian agriculture during seventies, no doubt, went in favour of high production as well as productivity. But the additional workforce employed in agriculture of different states during this period seems to have accentuated the degree of underemployment causing a sharp decline in marginal productivity of agricultural workers.[15]

On the other hand, according to the cross-section analysis of the above table, the marginal productivity of irrigation and fertilizer in most of the developed states at both the points of time was found to be lower as compared to the corresponding productivities in the developing states. The intensity of input use seems to provide a plausible explanation for this phenomenon. As shown in table 3, the intensity of irrigation use in developed states with an already high base in 1970-71 showed a remarkably higher rate of increase (26.33%) during 1980-81 as compared to the growth of output (22.76%).

Table 3 : Changes in Intensity of Input Use and Agricultural Productivity

States	Consumption of Fertilizer per ha. of net area sown (Kg.)			Irrigation Coverage (Percentage)			Agrl. workers employed per 00 ha. of net area sown (No.)			Value of agrl. produce per ha. of net area sown (Rs.)		
	1970-71	1980-81	% increase (+)/ decrease (-)	1970-71	1980-81	% increase (+)/ decrease (-)	1970-71	1980-81	% increase (+)/ decrease (-)	1970-71	1980 81	% increase (+)/ decrease (-)
A. Developed States												
1. Tamil Nadu	41.98	78.60	+ 87.23	41.31	45.96	+11.26	147.48	185.52	+25.79	1341	1404	+ 4.85
2. Punjab	52.59	180.42	+243.07	70.42	78.09	+10.89	60.49	68.46	+13.18	1678	2510	+49.58
3. Haryana	19.37	63.10	+225.76	39.68	52.55	+32.43	48.61	61.02	+25.53	1264	1679	+32.83
4. Kerala	26.09	44.24	+ 69.57	19.53	12.34	-36.82	138.80	127.25	- 8.32	741	815	+ 9.99
5. U. P.	23.72	65.78	+177.32	39.00	50.86	+30.41	122.23	138.06	+12.95	1345	1706	+26.84
6. A. P.	24.13	50.72	+110.19	27.71	32.21	+16.24	107.57	138.63	+28.87	726	901	+24.10
7. Gujarat	16.95	39.40	+132.45	11.99	17.97	+49.87	56.70	69.19	+22.03	632	768	+21.52
8. West Bengal	13.33	51.06	+283.05	26.55	26.88	+ 1.24	132.29	153.14	+15.76	1567	1627	+ 3.83
Total	27.27	71.67	+162.82	34.52	43.61	+26.33	101.77	117.66	+15.61	1162	1427	+22.76
B. Developing States												
9. H. P.	10.44	28.88	+176.63	17.09	15.86	- 7.20	175.20	185.67	+ 5.98	1107	1140	+ 2.98
10. Bihar	11.74	23.97	+104.17	27.15	34.69	+27.77	170.17	192.32	+13.02	838	966	+15.27
11. Karnataka	15.20	33.34	+119.34	11.22	13.66	+21.75	66.26	86.06	+29.88	581	742	+27.17
12. Orissa	4.98	12.53	+151.61	16.85	18.83	+11.75	94.71	105.79	+11.70	833	863	+ 3.60
13. Maharashtra	11.28	23.07	+104.52	7.75	10.49	+35.35	67.53	82.25	+21.80	501	612	+22.16
14. Rajasthan	3.54	8.73	+146.61	15.72	18.31	+16.48	39.36	46.51	+18.17	339	397	+17.11
15. M. P.	4.39	10.44	+137.81	7.78	12.28	+57.84	66.19	81.03	+22.42	544	611	+12.32
Total	8.80	20.14	+128.83	14.79	17.73	+19.89	97.06	111.38	+14.75	678	862	+27.14
INDIA	15.55	38.59	+148.17	21.81	26.56	+21.78	89.75	103.56	+15.39	797	990	+24.22

Whereas in the developing states, the increase in the growth rate of intensity of irrigation use (which had a low base in 1970-71) during this period was noticed to be lower (19.89%) than the growth rate of output (27.14%). Thus, compared with the growth rate of output, a relatively higher growth rate of intensity of irrigation use in the developed states and the reverse situation in the developing states seem to have resulted in the lower order of marginal productivity of irrigation in the former as compared to the latter. Moreover, in case of the marginal productivity of fertilizer, the position appears to be somewhat mixed : the aforesaid argumentation, no doubt, goes in favour of the developed states but proves to be contradictory in respect of the developing states. In spite of this, efforts to raise intensity of input use are still required to continue so long the point of output maximisation is not attained. Besides, the marginal productivity of agricultural workers in most of the developed states during seventies is noticed to be much higher as compared to the developing ones obviously because of the higher levels of efficiency, modernisation and better exploitation of the existing resource potentials.

V. Investment on Irrigation, Potential Created and Its Utilisation

The functional analysis attempted in the preceding section identifies irrigation as playing the most contributory role in agricultural production among the set of the selected independent variables.[16] It is, therefore, deemed imperative

here to examine and analyse, in greater detail, the pattern of investment, potential created and its utilisation under irrigation sector.

Considering irrigation as the most important plank of the strategy, the Government of India aimed at enhancing agricultural production during each of the Five Year Plans. As a result, approximately 12.3 per cent of the total plan outlay (Rs.1,64,434 crores) are likely to be invested on development or irrigation upto the end of the Sixth Plan, details of which are given in Table 4.

Against the total financial allocation for irrigation development upto the end of the Sixth Plan, nearly 79 per cent are likely to be invested on major/medium irrigation workers and the rest only 21 per cent would go to minor irrigation works. Contrary to this, the irrigation potential likely to be developed through the latter over the period is estimated to be much higher (54.02 per cent) as compared to the former (45.98 per cent). Moreover, there does not seem to be any consistent relationship between the investment made and the potential created. For example, the investment per ha. of irrigation potential created in the First Plan at 1950-51 prices was low (Rs.1,027) as compared to Rs.1,546 during the Sixth Plan. The corresponding figures in respect of major/medium irrigation works are calculated at Rs.1,200 and Rs.3,047 respectively and those for minor irrigation works come to Rs.655 and Rs.469. On an average, the investment per ha. of irrigation potential for major irrigation works is three

Table 4 : Outlay for Development of Irrigation Potential in India

Plans	Outlay (Rs. crores)			Irrigation Potential Created (M. ha. cumulative)		
	Major	Minor	Total	Major	Minor	Total
Pre-Plan Benefits	-	-	-	9.70 (42.92)	12.90 (57.08)	22.60 (100.00)
First Plan	300 (83.33)	76 (16.07)	376 (100.00)	12.20 (46.46)	14.06 (53.54)	26.26 (100.00)
Second Plan	380 (72.80)	142 (27.20)	522 (100.00)	14.30 (49.16)	14.79 (50.84)	29.09 (100.00)
Third Plan	581 (63.92)	328 (36.08)	909 (100.00)	16.60 (49.39)	17.01 (50.61)	33.61 (100.00)
Annual Plans (1966-69)	434 (57.11)	326 (42.89)	760 (100.00)	18.10 (48.79)	19.00 (51.21)	37.10 (100.00)
Fourth Plan	1237 (70.69)	513 (29.31)	1750 (100.00)	20.70 (46.83)	23.50 (53.17)	44.20 (100.00)
Fifth Plan	2442 (78.47)	631 (20.53)	3073 (100.00)	24.82 (47.62)	27.30 (52.38)	52.12 (100.00)
Annual Plans	2056 (80.53)	497 (19.47)	2553 (100.00)	26.60 (47.00)	30.00 (53.00)	56.60 (100.00)
Sixth Plan	8448 (82.36)	1810 (17.64)	10258 (100.00)	32.34 (45.98)	38.00 (54.02)	70.34 (100.00)
Total	15878 (78.60)	4323 (21.40)	20201 (100.00)	32.34 (45.98)	38.00 (54.02)	70.34 (100.00)

Note : Figures given in parentheses denote percentages to horizontal totals.

Source: Government of India, Sixth Five Year Plan - 1980-85, Planning Commission, New Delhi, p.148.

times greater than that of minor irrigation works. Thus, the development of irrigation potential through the latter seems to be much more economical and better rewarding. This conforms to the findings of the World Bank : 'Investment in irrigation is economically appropriate and advantageous. Rates of return to investment in public surface irrigation projects are low but acceptable. Rates of return for ground water development, are higher.'[17]

An allocation of financial resources for development of irrigation potential during the Sixth Plan showed a wide variation from one state to another. All the developed states excepting Tamil Nadu and Andhra Pradesh got this outlay per ha. of net area sown above the national average, whereas almost all the developing states except Bihar received this outlay below the national average (Appendix I). Thus, the principle of providing higher allocations of financial resources to backward states, while duly conceived in the plan documents yet was not adhered to in actual practice.

We further notice that about 73 per cent of the total ultimate irrigation potential is likely to be created in developed states by the end of the Sixth Plan (Appendix I). Whereas the corresponding percentage for developing states works out to 61 only, as against the all-India average of 68 per cent. These percentages in respect of major/medium irrigation works for developed and developing states are found to be 66 and 63 respectively and those of minor irrigation works account for 80 and 58.

Thus, the balance of safe yield, which could be converted into irrigation potential in future, is 27 per cent of the ultimate irrigation potential in developed states and 39 per cent in developing states, as against the national average of 32 per cent (Appendix I). This balance in respect of major/medium irrigation works is around 35 per cent in both kinds of states, but the same in respect of minor irrigation works significantly differs from 20 per cent in developed states to 42 per cent in developing states. More specifically, considering the proportion of the net balance to ultimate irrigation potential, the states requiring priority for development of irrigation potential through major/medium irrigation works are identified as Haryana, Uttar Pradesh and Gujarat of developed category and Himachal Pradesh, Bihar, Karnataka, Orissa and Maharashtra of developing category. Whereas the states requiring special treatment for development of the irrigation potential through minor irrigation works include Kerala, Andhra Pradesh and West Bengal of developed category and Himachal Pradesh, Bihar, Karnataka, Orissa, Maharashtra and Madhya Pradesh of the developing category. The states of the latter category have considerable ground water potential but could not move fast possibly on account of the low level of electrification, weak cooperative structure and insufficient flow of institutional credit.

Turning to the aspect of utilisation, we notice that by the end of the Sixth Plan nearly 87 per cent of the irrigation potential created through major/medium irrigation works is likely to be utilised in developed states, whereas the corres-

ponding percentage in respect of developing states is estimated to be considerably low (58.80%), as against the national average of 74.34 per cent (Appendix I). More specifically, the states having this utilisation percentage below the national average include Gujarat of developed states and Himachal Pradesh, Bihar, Maharashtra and Madhya Pradesh of developing states. The low utilisation of the irrigation potential in these states is mainly attributed to the delay or absence of construction of water courses/field channels, land levelling and land shaping and non-introduction of Warabandi or rotational water supply system. This calls for the close monitoring of projects at short intervals to ensure better exploitation of water resources through removal of the aforesaid deficiencies within the stipulated time schedule.

VI. Conclusions

The elasticities of agricultural production function reveal that decreasing return to scale operated in Indian agriculture during the period 1971-81. But there was some definite improvement in its overall performance as witnessed by an increase in the sum of elasticities of value of agricultural produce per ha. of net area sown in respect of the selected independent variables from 0.80 in 1970-71 to 0.89 during 1980-81. Moreover, the changes in relative sizes of the elasticities indicate that value of agricultural produce per ha. of net area sown has become the most responsive to irrigation and fertilizer in the existing macro-economic structure of Indian agriculture. The former with statistically significant t-values

played the most contributory role in agricultural production during the selected two points of time, and fertilizer stood at second and occupied the position only next to irrigation during 1980-81. But a sharp reduction in the elasticity of value of agricultural produce per ha. of net area sown in respect of agricultural workers indicates that the rise in its strength during the decade has not gone in favour of augmenting the level of agricultural productivity.

Apart from showing an increasing trend at the national level, the marginal productivity of irrigation (MPI) in most of the developed states using high yielding input combinations appreciably increased during seventies, but the corresponding figures in most of the developing states using low yielding input combinations showed a considerable decline. Although the marginal productivity of fertilizer (MPF) showed a significant increase at the national as well as sub-national levels during this period, the marginal productivity of agricultural workers (MPAW) experienced a sharp decline at both the levels. Thus, adoption of the irrigation-fertilizer technology in Indian agriculture during seventies, no doubt, went in favour of high production and productivity. But the additional work force employed in agriculture of different states during this period seems to have accentuated the degree of underemployment causing a sharp decline in the marginal productivity of agricultural workers. Thus, under the present techno-economic conditions, a further absorption of the additional labour force in agriculture does not seem to be an economically viable proposition.

Compared with the growth of output, a relatively higher growth of intensity of input use in developed states and the reverse situation in developing states seem to have resulted in the lower order of marginal productivity of irrigation and fertilizer in the former. But efforts to raise intensity of input use particularly irrigation are still required to continue so long the point of output maximisation is not attained. Besides, the marginal productivity of agricultural workers in most of the developed states during seventies was noticed to be much higher as compared to the developing ones primarily because of the higher scales of efficiency, modernisation and better exploitation of the existing resources.

The investment per ha. of irrigation potential on major/ medium irrigation works in India upto the Sixth Plan is found to be three times greater than that of the minor irrigation works. But the irrigation potential likely to be developed through the latter is estimated to be much higher as compared to the former. Thus, the development of irrigation potential through minor irrigation works seems to be much more economical and better rewarding.

A wide variation in allocation of financial resources for development of irrigation during the Sixth Plan is noticed from one state to another. Almost all the developed states got this outlay per ha. of net area sown above the national average, whereas a majority of the developing states received the corresponding outlay below the national average. Thus, the principle of providing higher allocations of financial

resources to backward states, although duly conceived in the plan documents, but was not adhered to in actual practice.

Further more, considering the proportion of the net balance to ultimate irrigation potential, the states, requiring priority in terms of higher allocations of financial resources for development of irrigation through major/medium irrigation works are identified as Haryana, Uttar Pradesh and Gujarat of developed category and Himachal Pradesh, Bihar, Karnataka, Orissa and Maharashtra of developing category; whereas those requiring higher allocations of financial resources for development of irrigation through minor irrigation works include Kerala, Andhra Pradesh and West Bengal of the developed category and Himachal Pradesh, Bihar, Karnataka, Orissa, Maharashtra and Madhya Pradesh of the developing category.

The under-utilisation of the existing irrigation potential created through major/medium irrigation works is found to be comparatively high in the states of Gujarat, Himachal Pradesh, Bihar, Maharashtra and Madhya Pradesh. This calls for the close monitoring of the major/medium irrigation projects at short intervals to better ensure exploitation of the water resources through maximum possible improvement in the construction of water courses/field channels, land levelling/shaping and implementation of the rotational water supply system.

Appendix I

State-wise Ultimate Irrigation Potential, Irrigation Potential Likely to be Developed and Balance of Safe Yield by the End of Sixth Plan

(000 Ha. Gross)

States	Ultimate Irrigation Potential			Irrigation Potential Developed/Likely to be Developed			Expected Balance of Safe Yield			% utilisation of irrigation potential created through major/medium irrigation works	Irrigation outlay per ha. of net area sown during the VI Plan (Rs.)
	Major/ Medium	Minor	Total	Major/ Medium	Minor	Total	Major/ Medium	Minor	Total		
1	2	3	4	5	6	7	8	9	10	11	12
A. Developed States											
Tamil Nadu	1500	2400	3900	1245 (83.00)	2054 (85.58)	3299 (84.59)	255 (17.00)	346 (14.42)	601 (15.41)	98.80	360
Punjab	3000	3550	6550	3000 (100.00)	3154 (88.55)	6154 (93.94)	0 (00.00)	396 (11.55)	396 (6.06)	82.13	949
Haryana	3000	1550	4550	1920 (64.00)	1404 (90.58)	3324 (73.05)	1080 (36.00)	146 (9.42)	1226 (26.95)	92.50	1599
Kerala	1000	1100	2100	666 (66.60)	405 (36.82)	1071 (51.00)	334 (33.40)	695 (63.18)	1029 (49.00)	96.85	1490
Uttar Pradesh	12500	13200	25700	7229 (57.83)	12190 (92.35)	19419 (75.56)	5271 (42.17)	1010 (7.65)	6281 (24.44)	84.95	885
Andhra Pradesh	5000	4200	9200	3457 (69.14)	2335 (55.60)	5792 (62.96)	1543 (30.86)	1865 (44.40)	3408 (37.04)	92.02	815
Gujarat	3000	1750	4750	1290 (43.00)	1624 (92.80)	2914 (61.35)	1710 (57.00)	126 (7.20)	1836 (38.65)	60.93	1760
West Bengal	2310	3800	6110	1723 (74.59)	1920 (50.53)	3643 (59.62)	587 (25.41)	1880 (49.47)	2467 (40.38)	93.04	1089
Total	31310	31550	62860	20530 (65.57)	25086 (79.51)	45616 (72.57)	10780 (34.43)	6464 (20.49)	17244 (27.43)	86.83	947

Appendix I (contd.)

1	2	3	4	5	6	7	8	9	10	11	12
B. Developing States											
Himachal Pradesh	50	285	335	21 (42.00)	119 (41.75)	140 (41.79)	29 (58.00)	166 (58.25)	195 (58.21)	38.10	620
Bihar	6500	5900	12400	3117 (47.95)	3350 (56.78)	6467 (52.15)	3383 (52.05)	2550 (43.22)	5933 (47.85)	73.65	1417
Karnataka	2500	2100	4600	1474 (58.96)	1330 (63.33)	2804 (60.96)	1026 (41.04)	770 (36.67)	1796 (39.04)	93.08	517
Orissa	3600	2300	5900	1680 (46.67)	1071 (46.57)	2751 (46.63)	1920 (53.33)	1229 (53.43)	3149 (53.37)	100.00	771
Maharashtra	4100	3200	7300	1785 (43.54)	1957 (61.16)	3742 (51.26)	2315 (56.46)	1243 (38.84)	3558 (48.74)	59.66	729
Rajasthan	2750	2400	5150	1867 (67.89)	1962 (81.75)	3829 (74.35)	883 (32.11)	438 (18.25)	1321 (25.65)	88.27	337
Madhya Pradesh	6562	4200	10762	6562 (100.00)	2050 (48.81)	8612 (80.02)	0 (00.00)	2150 (51.19)	2150 (19.98)	22.02	588
Total	26062	20385	46447	16506 (63.33)	11839 (58.08)	28345 (61.03)	9556 (36.67)	8546 (41.92)	18102 (38.97)	58.81	672
Grand Total (A + B)	57372	51935	109307	37036 (64.55)	36925 (71.10)	73961 (67.66)	20336 (35.45)	15010 (28.90)	35346 (32.34)	74.34	851

Note : Figures in parentheses given in columns 5 & 8, 6 & 9 and 7 & 10 denote percentages to columns 2, 3 and 4 respectively.

Source : Government of India, Sixth Five Year Plan 1980-85, Planning Commission, New Delhi, pp.162-163.

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13. The value of agricultural produce for each of the selected states separately for the years 1970-71 and 1980-81 was estimated after multiplying the quantity of total produce for each of the selected 25 crops by the harvest prices of the respective crops. Moreover, to make the values of both the years comparable, values of agricultural produce of 1980-81 for different states were deflated at constant prices of 1970-71, using the wholesale price index of agricultural commodities.

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15. The strength of agricultural workers at the national level showed an increase of 17.71 per cent during the period 1971-81. A similar kind of rising trend is perceptible in almost all the states except Kerala where the workers' strength has reduced by about 7 per cent. See, Census of India - 1971 and 1981.

16. Analytically, irrigation as an essential input is so vital that it captures the effects of other agricultural inputs like fertilizer and high yielding variety seeds. It permits use of better seed fertilizer combinations and enables productivity schedule to shift upwards, besides increasing employment elasticity of output through encouraging multiple cropping. See, L.K. Sen, 'Role of Irrigation in Integrated Area Development Planning' in (ed.), Role of Irrigation in the Development of India's Agriculture, Indian Society of Agricultural Economics, Bombay and Institute of Social and Economic Change, Bangalore, December 1975, pp.150-159.

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